

of theory and demonstration. The student of physics is somewhat differently circumstanced. From time immemorial physical research and mathematical methods have been more or less closely associated, and every student of physics knew that a certain knowledge of higher mathematics was demanded of him. Yet complaints have been heard even from him that the mathematical courses in our colleges lacked a certain flavour of the real, and were not particularly suited to his needs. It has often been said that there is no royal road to mathematical knowledge. To quote Dr. Mellor himself, a certain amount of drudgery is necessary in some stages. But some roads are easier than others; and in this book chemical and physical problems are introduced, like rest houses along a weary way, to cheer the flagging traveller. Here he finds familiar food for his mind. To change the metaphor, the student is given a new weapon, and at the same time is taught how to use it on material already his.

To what extent the reader, otherwise ignorant of the principles of the differential calculus, will be able to appreciate the first chapter, experience alone can tell. The introduction of sections on proportionality and logarithms in the middle of the discussion of differentiation does not strike one favourably. The author's reference to this in the preface may, however, be accepted as sufficient excuse.

The new edition is fundamentally the same work as the old, but about a fifth more bulky. The increase in size is due partly to a more sparing use of small type, but chiefly to the introduction of new matter. There is also a good deal of re-arrangement of individual sections, such, for example, as the carrying forward of the paragraphs on the Gamma and elliptic functions from chapter iv. (the integral calculus) to chapter vii. (how to solve differential equations). From a physical point of view this is undoubtedly the better arrangement; and there is a further improvement which deserves notice, namely, the leading up to each of these functions by the discussion of a comparatively simple dynamical problem. The most obvious addition is the new chapter on the calculus of variations, in which brachistochrones and isoperimetrical problems are touched upon. Probably the main service rendered by this chapter will be to enlarge the outlook of the student. The class of readers for whom the book is ostensibly written will hardly ever be called upon to apply the calculus of variations, and if they should be they would find the discussion too meagre for them to make effectual use of it; but it is a real service to open a man's mind to the things which lie beyond the immediate purpose of his life. The still too common utilitarian idea that the practical man should be taught just as much mathematics as we know to be necessary for his immediate needs is an idea which cannot be too strenuously contested. The truth is, we never know what will be needed before the year is out. The chemist of the last generation would as soon have thought of studying the properties of Theta functions as of familiarising himself with the modes of solution of the simpler differential equations, or even with the

meaning of a differential coefficient; but that attitude of mind is impossible now. The theoretical chemist of the rising generation must know his mathematics, and we are convinced that many will bless Dr. Mellor for providing them with an eminently readable and thoroughly practical treatise.

Throughout the book there are many historic notes which are always interesting in their way. It will not, then, be thought amiss to direct attention to the section on pp. 59 and 60, and to ask why writers are so slow to do Newton justice in regard to his so-called law of cooling. It is now six years since Prof. Crichton Mitchell, in a paper on the convection of heat by air currents (*Trans. R.S.E.*, vol. xl. p. 39), pointed out, what seems to have escaped the notice of every commentator except Fourier, that Newton deliberately placed his cooling body "non in aere tranquillo, sed in vento uniformiter spirante." Dulong and Petit, therefore, and all their copiers, including Dr. Mellor himself, are not giving "a typical example of the way in which the logical deductions of an hypothesis are tested" when they try to apply Newton's law to a body cooling in tranquil air. Crichton Mitchell showed that when Newton's conditions were realised Newton's law held with wonderful accuracy over a considerable range of temperature differences.

C. G. K.

PLANT DISEASES.

Minnesota Plant Diseases. By Dr. E. M. Freeman. Pp. xiii + 432. (St. Paul, Minnesota: The Pioneer Press.)

THIS publication is issued for "the people of Minnesota" by authority of the university of that State. It may have special reference to a particular State, but it is quite evident, from a perusal of its pages, that the book will be of service wherever plants are cultivated. The author takes a broad view of his subject, and rightly considers the prevention of disease as a more important matter, from the point of view of the cultivator, than the application of remedies. "Agriculture," says he, "really resolves itself into one great problem, the prevention of plant-disease." Keep the "patient" in good health by careful attention to his physiological requirements, by cleanliness and by strict compliance with the teachings of hygiene. Much more good will ensue from these measures than from the use of insecticides or anti-fungus sprays. A knowledge of the life-history of the plant, as well as a corresponding familiarity with the mode of life of the hostile insect or fungus, is, indeed, essential, but unless combined with the faculty of turning that knowledge to account, the information is, practically speaking, of no value.

The first question that is asked when a diseased specimen is submitted is, "What is the matter with this plant?" The next, and in the view of the questioner the most important, is, "What am I to do to get rid of the disease?" Not one in a hundred cucumber-growers, cultivators of the vine or other crops, asks a question as to the methods of preven-

tion; the ninety and nine ask for a "cure." Yet whilst prevention is often within reach, cure, in the proper sense of the word, is frequently impossible. The diagnosis of the disease must be left to the skilled expert, the means of prevention should be known to all intelligent cultivators, the remedy may be prescribed by the plant-doctor, whilst the "cure," which often means the bonfire, may be entrusted to the labourer.

Another point which cannot be overlooked in considering the prevention of epidemic diseases is the necessity for concerted action. If one cultivator is alive to the exigencies of the case his labour is often vain if his neighbour be slovenly and apathetic.

The book before us is divided into two parts, the first dealing with the fungi which are injurious to plants generally, the second with the specific diseases of Minnesota vegetation. The account of the nature, mode of growth, and habits of fungi is written clearly and in a style readily comprehensible by the reader of average intelligence. It forms, indeed, an excellent introduction to the study of fungi.

A separate chapter is given to the history of the bacteria which presents in a concise form many details of the utmost importance to cultivators. After these generalities attention is directed to the fungous diseases most prevalent in Minnesota. To these we need not here specially refer, nor to the sections on fungicides and spraying apparatus. We can only add that the book is well illustrated and provided with a copious index. We commend it to the notice of all who are interested in plant-diseases, and especially to foresters and cultivators of field or garden plants.

OUR BOOK SHELF.

Mesure et Développement de l'Audition. By Dr. Marage. Pp. 119. (Paris, 1905.)

THIS small volume by Dr. Marage is of scientific value inasmuch as it contains an account of a method by which acuteness of hearing can be measured, and by which any degree of deafness can also be stated with accuracy. Aurists for many years have made use of the ticking of a watch, the sound of a tuning-fork, or a percussion sound as a source of sound, and they state the degree of deafness by a measurement of the distance at which the patient can hear the sound as compared with the efficiency of a normal ear. The best of all acoumeters, no doubt, is the human voice, as it gives sounds to which the ear is adapted; but no two human voices are alike, in consequence of the variations in quality caused by the vocal resonating cavities.

Dr. Marage, however, has invented a siren which is furnished with resonating masks (casts of the vocal cavities as adapted for the vowels OU, O, A, E, and I). This apparatus utters these vocal tones with singular purity. The form of the mask, and especially that of the oral opening in each case, suppresses most, if not all, of the overtones for each vowel, and the laryngeal vowel tone (produced by the siren) is alone sounded. Further, he has shown that the intensity of the sound of this instrument, as measured by a special water-manometer, is proportional to the pressure of the air which traverses the apparatus. The siren can be adjusted for any vowel, and the apparatus is always at the same distance from the ear. The measurement of the auditive acuity is given

in the number of millimetres of water shown in the manometer when the sound of the particular vowel is heard. Thus any vowel sound is heard with a pressure of 1 mm. by a normal ear; if the pressure must be raised to 40 mm. before the sound is heard the auditive acuity is $1/40$, if at 60 mm. $1/60$, if at 200 mm. $1/200$, and so on.

Dr. Marage also shows an ingenious method of recording on a chart the degree of acuity for each vowel, always in mm. of water, and if the points for the various vowels are joined a curve is produced. The form of this curve varies with different pathological conditions of the middle and internal ear, so that after the patient's ear has been tested for the vowel tones by the siren, and the curves have been plotted out, the form of the curve is of value in diagnosis. Lastly, Marage uses the siren to massage the drum-head and chain of bones by giving to the ear for a certain time, say a daily massage of ten minutes, using the vowel tones of the instrument, and he asserts, and shows by charts, that in a large percentage of cases of many forms of ear trouble, and in some cases even of deaf mutism, there is benefit derived from the massage treatment. These results cannot be criticised in a scientific journal, as they pertain more to the region of the practical aurist, but there can be no doubt of the value of the method of Marage as a method of accurately determining acuteness of hearing.

JOHN G. MCKENDRICK.

American Insects. By Vernon L. Kellogg. Pp. vi+674; 812 illustrations and 13 plates. (New York: Holt and Co.; Westminster: A. Constable and Co., Ltd., 1905.) Price 21s. net.

THIS work is intended as an introduction to North American entomology. It consists of a systematic review of the various orders of insects met with in America north of Mexico, and of introductory and supplementary chapters dealing with special subjects. The three introductory chapters on structure, physiology, development and classification are well done, a great deal of information being condensed in these 50 or 60 pages.

The supplementary chapters are, however, the best part of the book. They are (1) insects and flowers; (2) colour and pattern and their uses; (3) insects and disease. These subjects are treated in an intelligent manner, with an absence of dogmatism that is very commendable.

In some parts of the work the author is a little more rash. Thus he concludes his account of the slave-making ant, *Polyergus*, with the dictum "specialization is leading *Polyergus* to its end!" Whether this is the case must be left to the future to decide. It would have been simpler to say that *Polyergus* has mandibles unsuited for industrial purposes, and comparatively possesses slave-making habits that do not appear to be very successful.

Of the systematic part of the work we cannot speak so highly; this is chiefly due, it is only fair to say, to inadequate space. There are, as the author says, 10,000 kinds of beetles in North America, as against 1000 kinds of birds. It is small wonder that the attempt to condense an account of 10,000 species and their habits and life-histories into 54 pages does not leave a satisfactory impression. The extensive orders Coleoptera and Diptera have suffered most from their abbreviation. The Coleopterous portion, moreover, has not been adequately revised, the larva of a Longicorn beetle being figured as a type of the larvæ of the Buprestidæ.

Notwithstanding these drawbacks, the work is probably the best that exists for anyone desiring an introductory work on North American insects compressed into a single volume.

D. S.